NATURAL REGENERATION ON OLD FIELDS IN SOUTHEASTERN OHIO

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INTRODUCTION

The land-use pattern of the hill region of southeastern Ohio is characterized by (1) forests, chiefly found on the steeper lands, (2) pasture and crop lands, confined generally to the valley bottomlands and the gentler slopes, (3) coal strip-mined lands, occupying extensive areas in some counties, and (4) open weed and grasslands that were cleared for agriculture and later abandoned.

The abandoned agricultural lands, or so-called old fields, are of particular interest to foresters as they constitute an important reforestation problem in southeastern Ohio. Some of these lands are being reclaimed for agricultural purposes, but the consensus is that the steeper, eroding slopes should be planted to trees. Within large blocks of land managed by individuals, corporations, or the public for forest purposes, most of the old fields are planted to trees as fast as funds and supplies of seedling trees permit.

It has been estimated that there are from 1 to 3 million acres of old-field land in Ohio. In the Athens Ranger District of the Wayne National Forest, comprising 55,000 acres in Government ownership, about 25 percent of the land is in old fields.

Before an adequate reforestation program can be planned, it is necessary to know to what extent successful natural tree seeding is occurring on these lands. For example, the estimate of old-field land needing tree planting on the Athens Ranger District is based on cultural maps made in 1935. Although casual observation may be misleading concerning the changes that have taken place since that time due to natural seeding, it is apparent in many places that noncommercial tree species have become established. There is also evidence that some cleared lands have completely reverted to forest cover of commercial value.

This study was made in 1950 within the Wayne National Forest to determine the number and species of trees that have become established on lands that were classified as old fields in 1935.

METHODS

Three townships, believed by the district ranger to be representative of the district, were selected for sampling. Two were located in Hocking County and one in Perry County. Twenty old fields were selected for study in each of the three townships. Township maps showing forest types and nonforested lands in 1935 served as a basis for selecting the fields.

The 60 old fields sampled totaled 850 acres. On these fields 636 plots 0.01 acre in size were examined. The distribution of these plots by field size within townships is shown in table 1. All aspects of sloping lands as well as ridges and bottoms were included in the fields studied. The distribution of the plots by topographic exposure is given in table 2.

Table 1.--Number of 0.01-acre old-field plots sampled in southeastern Ohio, by township and field size

Township and county	Size of field (acres)					Total
	0-10	11-20	21-30	31-40	41-50	
	Number					
Monroe, Perry County	80	70	40	--	40	230
Ward, Hocking County	35	76	90	20	--	221
Starr, Hocking County	55	100	30	--	--	185
Total	170	246	160	20	40	636

All fields larger than 2.5 acres were considered as possible sampling units, but fields larger than 45.0 acres were subdivided into two or more smaller units. This was done because it was difficult to determine logical boundaries for sampling very large fields. Of all the possible old-field units in a township, 20 were randomly selected for examination. Alternate choices were made to be substituted for original units that were rejected because of change in use, recent burning, grazing, or because they could not be located.

The fields were sampled as follows: The approximate field center was first located. Radii were chosen randomly from eight compass points: N, NE, E, SE, S, SW, W, and NW. Along each bearing a plot was located at a randomly selected distance from the

Table 2.--Number of old-field plots sampled, by township and topographic exposure

Township and county	Topographic exposure										Total
	N	NE	E	SE	S	SW	W	NW	Ridge	Bottom	
	Number										
Monroe, Perry County	38	25	35	23	31	11	26	18	12	11	230
Ward, Hocking County	25	27	30	23	28	15	40	9	8	16	221
Starr, Hocking County	20	19	24	11	30	14	34	22	10	1	185
Total	83	71	89	57	89	40	100	49	30	28	636

field center in such a way as to correct for convergence of bearings.1/ Five 0.01-acre plots were located in fields of 10.0 acres or less; 10 plots in fields 11.0 through 20.0 acres; and 20 plots in larger fields.

RESULTS AND DISCUSSION

Nearly 60 percent of the trees found on the fields were less than 6 years old. Almost 80 percent were less than 10 years old. This distribution indicates either that there is a high mortality at an early age, or that natural stocking has been occurring at an increasing rate since the fields were abandoned. It is possible that variation in age of the fields beyond 15 years might affect the stocking. Some areas mapped as old fields in 1935 may have been abandoned as early as 1900 while others may have been abandoned shortly before the mapping was done. There was no way to determine the age of the fields beyond 15 years. The distribution of trees found by age classes is shown in table 3.

Table 3.--Percent of old-field plots in each township containing trees, by age classes

Township and county	Age class (years)						Total
	0-5	6-10	10-15	16-20	21-25	26	
	Percent						
Monroe, Perry County	62	18	8	8	3	1	100
Ward, Hocking County	41	24	22	9	2	2	100
Starr, Hocking County	70	15	8	5	1	1	100
Average	59	19	12	7	2	1	100

As would be expected, the distribution of trees by size classes is similar to that of age. Nearly 70 percent of the trees found were under breast height as shown in table 4.

1/ R. N. Gaiser. Random sampling within circular plots by means of polar coordinates. Jour. Forestry 49:916-917. Dec. 1951.

Table 4.--Percent[1/] of old-field plots in each township containing trees, by stem diameter classes

Township and county	Trees under breast height	Diameter at breast height (inches)						Total
		0.0-0.5	0.6-1.5	1.6-2.5	2.6-3.5	3.6-4.5	4.6 & over	
	Percent							
Monroe, Perry County	70	17	8	2	1	1	1	100
Ward, Hocking County	52	29	12	3	2	1	1	100
Starr, Hocking County	76	9	8	4	1	1	1	100
Average	67	17	9	3	2	1	1	100

1/ Rounded off to nearest whole percentage. Fractions of 1 percent appear as "1".

A list of the trees found on the old fields examined appears in table 5 where they are grouped by (I) principal commercial species, (II) other commercial species, and (III) noncommercial species. The first group includes species that are of commercial importance and are usually major constituents in the forest stands in southeastern Ohio. Other commercial species, group II, have commercial importance but generally do not comprise a major part of the upland forests in this region.

Table 5.--Trees found on old fields in three townships in southeastern Ohio

Species[1]	Percent of total trees found	
Group I Principal commercial species		
Hickories	4.5	
Yellow-poplar	2.0	
White oak	1.5	
Black oak	1.5	
Red oak	1.0	
Scarlet oak, chestnut oak, black walnut, sycamore, beech, Virginia pine, black cherry	2.0	
Total, Group I		12.5
Group II Other commercial species		
Sassafras	35.5	
Elms	8.0	
Maples	4.0	
Ash	3.0	
Aspen	1.5	
Black locust, blackgum, bur oak, chestnut, cucumber, butternut, honeylocust, post oak, buckeye, basswood, persimmon, shingle oak, willow, mulberry	3.5	
Total, Group II		55.5
Group III Noncommercial species		
Crataegus	15.5	
Dogwood	6.5	
Ironwood and blue beech	3.0	
Redbud	2.5	
Chokecherry, sourwood, pawpaw, serviceberry, apple	4.5	
Total, Group III		32.0
TOTAL		100.0

1/ See complete list with scientific names in appendix.

Table 6.--Average number of trees per acre by field size in three townships of southeastern Ohio

Field size (Acres)	Number of plots	Number of trees tallied	Average number of trees per acre
0-10	170	3,514	2,067
11-20	246	5,556	2,259
21-30	160	3,331	2,081
31-40	20	294	1,470
41-50	40	171	428
Totals	636	12,866	
		Average	2,022

From table 6, which gives the average number of trees per acre by field size, it can be seen that the average stocking for the area examined was 2,022 trees per acre. Table 5 shows the total percentage of principal commercial species to be 12.5. This is an average of about 250 trees per acre. However, in figure 1 (line B) it can be seen that most of the fields were found in the 100 and 200 trees-per-acre classes. Figure 1 (line A) shows that 64 percent of the fields had less than 300 trees per acre. Also, only 9 percent of the fields had over 800 commercial trees per acre and might be considered as adequately stocked if they remain at that level. While every field examined had some reproduction, over one-fourth of the sample plots examined contained no trees of principal commercial importance. If the sample is representative, one-fourth of all similar abandoned field area found in this region has no reproduction of commercially important species. This is probably a conservative estimate of nonstocked land because no field units larger than 45 acres were examined in this study.

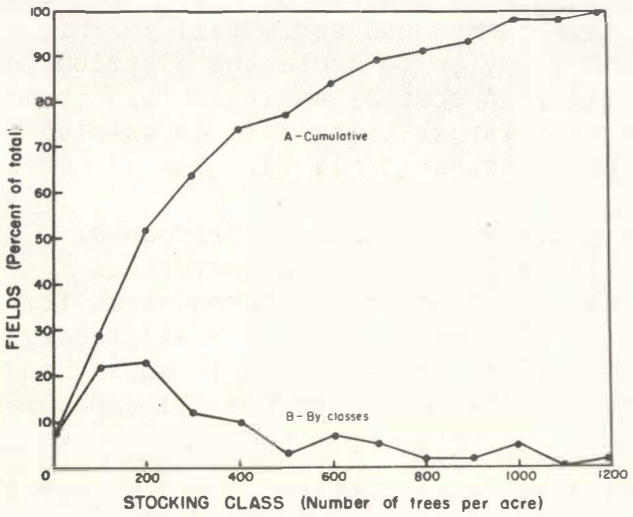

Figure 1.--Percentage distribution of fields by 100 trees-per-acre stocking classes for principal commercial species in southeastern Ohio. (A-Cumulative of all classes, B-Percentage by 100 trees-per-acre classes.)

The size of the field units had a significant effect on the number of principal commercial trees per acre that were found. Figure 2 shows the change in stocking with changes in field size. The rate of change is significant and it should be noted that there is apparently very little chance for the larger fields to become stocked for a long time. On an average, for every increase in field size of 10 acres (for fields from 5.0 to 45.0 acres in size) there was a reduction of over 30 percent in stocking (fig. 2) of principal commercial trees.

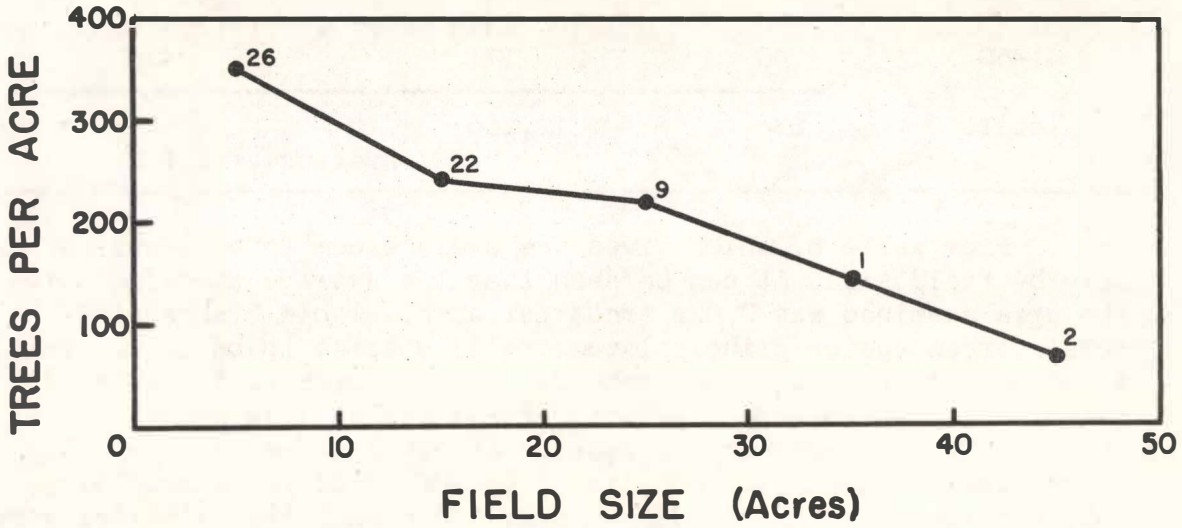

Figure 2.--Number of principal commercial trees per acre by field size in southeastern Ohio. (Numbers show number of observations.)

The topographic exposure of the land had no real influence on the stocking rate nor the size of the trees found, although as shown in figure 3 the stocking rates appeared to be highest on northeast and southwest slopes. A similar analysis for only the principal commercial trees did not show any evidence of exposure effect. It may be that the local prevailing winds, which are from southwest to northeast during late summer and early fall in this region,2/ blow the seeds in such a way as to cause the distribution pattern of the trees on the fields. A special analysis for hickory and yellow-poplar did not show that larger trees were associated with certain aspects as might be expected (table 7).

About 10 percent of the plots were located on ridges or bottomlands. The stocking on ridges for principal commercial species was about the same as was found on north slopes while for bottomlands it was only a quarter of these rates. For all trees, however, the rate on ridges and bottoms was very nearly equal, and both were very low in comparison to the mean rate for all exposures.

2/ C. L. Dow. 1952 personal communication. Ohio University.

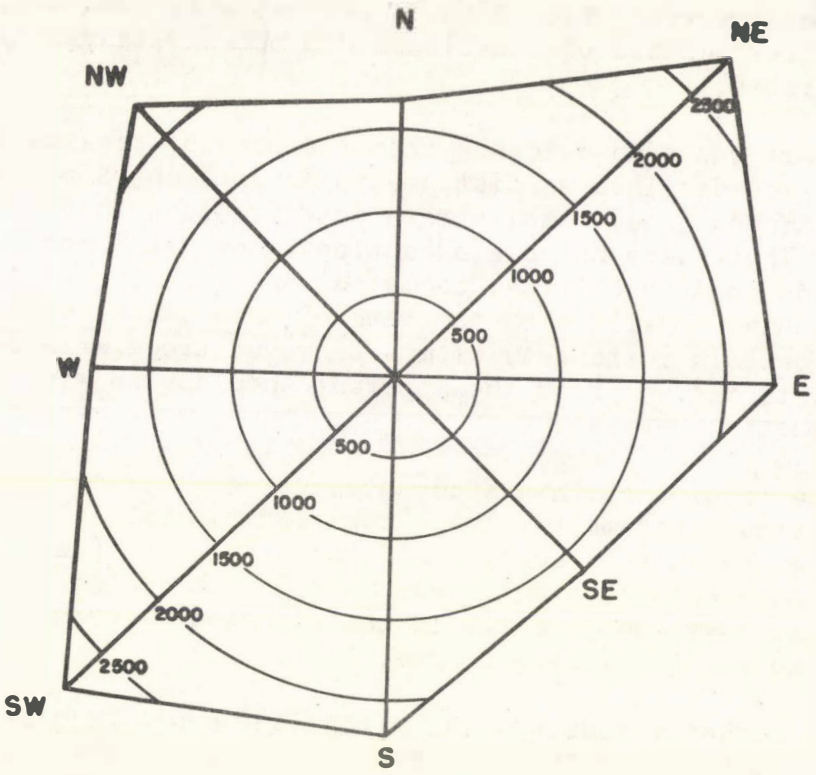

Figure 3.--Number of trees per acre found in the old-field study for eight aspects in southeastern Ohio.

Table 7.--The percentage distribution of hickory and yellow-poplar by exposures and diameter classes on old fields in Ohio

Plot exposure	Diameter at breast height (inches)						Total
	Under 0.5	0.6-1.5	1.6-2.5	2.6-3.5	3.6-4.5	Over 4.5	
	Percent						
North	5.0	1.5	0.5	1.0	---	0.5	8.5
Northeast	9.0	1.0	1.0	1.0	0.5	1.0	13.5
East	11.0	3.0	1.0	1.0	1.0	0.5	17.5
Southeast	7.0	1.0	1.0	1.0	1.0	0.5	11.5
South	8.0	1.0	1.0	1.0	---	0.5	11.5
Southwest	3.0	1.0	1.0	1.0	1.0	---	7.0
West	10.0	1.0	1.0	1.0	0.5	0.5	14.0
Northwest	7.0	1.0	---	0.5	---	0.5	9.0
Ridge	5.0	0.5	---	---	0.5	---	6.0
Bottom	1.0	0.5	---	---	---	---	1.5
Total	66.0	11.5	6.5	7.5	4.5	4.0	100.0

Slopes varying from 5 to 50 percent were sampled in the study. The steepness of the slopes did not have any effect on the stocking rates.

There was some evidence that the rate of tree reproduction in the fields declined as distance to an apparent seed source increased. Young trees usually were most frequent in fields next to a woods. There were notable exceptions, however. For example, many fields contained large, isolated, seed-bearing trees that seemed to have no effect on the rate of tree stocking in the field. Also, in certain instances, clumps of young trees were found at points quite distant from the apparent seed source with little or no reproduction between.

The results of this study have value in planning long-range tree planting programs for lands typified by the fields sampled. It has been shown that small fields have the best chance to regenerate through natural means. For this reason fields of 5 acres or less should have low priority in the planting program whenever they are next to a natural seed source.

In larger fields special attention should be given to examining the portions of the fields next to seed sources as it may not be necessary to plant limited areas because of natural reproduction.

No reliable estimate of the acreage of old-field land in the unglaciated portion of Ohio is available. It is believed that 1 million acres would be a conservative estimate. If all such land is chiefly valuable for forestry and is included in reforestation plans, a substantial saving can be made by careful preplanting examinations that will serve to eliminate naturally regenerating tracts from the planting program. On the Athens Ranger District of the Wayne National Forest it is estimated, using 1935 maps as a basis, that 14,000 acres need planting. At present costs it will take $168,000 to finance this program. Natural regeneration may result in a saving of nearly $17,000 in this instance.

SUMMARY

1. Sixty old fields, abandoned prior to 1935, comprising 850 acres, and located in three townships in southeastern Ohio were examined for natural tree reproduction. No field less than 2.5 acres nor larger than 45.0 acres was examined. A total of 636 plots of 0.01 acre in size supplied the data.

2. Nearly 80 percent of the trees found were less than 10 years old and nearly 70 percent were under breast height.

3. The average stocking, all species considered, was found to be 2,022 trees per acre but only 12.5 percent, or 250 trees per acre, were principal commercial species.

4. Field size had an important influence on the stocking rate; for principal commercial species an increase of 10 acres in field size decreased the stocking rate by one-third.

5. Topography and exposure did not appear to influence the stocking rate nor the size of the trees found. There was some evidence that the direction of the prevailing winds may affect the stocking rate by exposures.

6. Small old-field areas on 5 acres or less should have low priority in tree planting programs, and portions of larger fields that are next to seed sources should be examined for natural reproduction that may make planting unnecessary.

7. It is believed that about 10 percent of the old-field lands of the kind sampled in the region studied are regenerating satisfactorily to species of potential commercial value.

APPENDIX

Complete list of trees found on old fields in this study.

	Scientific name	Common name
1.	Acer negundo L.	Boxelder
2.	A. rubrum L.	Red maple
3.	A. saccharinum L.	Silver maple
4.	A. saccharum Marsh.	Sugar maple
5.	A. spicatum Lam.	Mountain maple
6.	Aesculus glabra Willd.	Ohio buckeye
7.	Ailanthus altissima (Mill.) Swingle	Tree-of-heaven
8.	Amelanchier canadensis L.	Serviceberry
9.	Asimina triloba (L.) Dunal	Pawpaw
10.	Carpinus caroliniana Walt.	Blue beech
11.	Carya cordiformis (Wangenh.) K. Koch	Bitternut hickory
12.	C. ovata (Mill.) K. Koch	Shagbark hickory
13.	C. tomentosa Nutt.	Mockernut hickory
14.	Castanea dentata (Marsh.) Borkh.	American chestnut
15.	Cercis canadensis L.	Eastern redbud
16.	Cornus florida L.	Flowering dogwood
17.	Crataegus spp.	Thornapple
18.	Diospyros virginiana L.	Persimmon
19.	Fagus grandifolia Ehrh.	American beech
20.	Fraxinus americana L.	White ash
21.	F. nigra Marsh.	Black ash
22.	F. pennsylvanica Marsh.	Red ash
23.	F. pennsylvanica var. lanceolata (Borkh.) Sarg.	Green ash
24.	Gleditsia triacanthos L.	Honeylocust
25.	Juglans cinerea L.	Butternut
26.	J. nigra L.	Black walnut
27.	Liriodendron tulipifera L.	Yellow-poplar
28.	Magnolia acuminata L.	Cucumbertree
29.	Malus spp.	Apple
30.	Morus rubra L.	Red mulberry
31.	Nyssa sylvatica Marsh.	Blackgum
32.	Ostrya virginiana (Mill.) K. Koch	Hophornbeam
33.	Oxydendron arboreum (L.) DC.	Sourwood
34.	Pinus virginiana Mill.	Virginia pine
35.	Platanus occidentalis L.	American sycamore
36.	Populus deltoides Bartr.	Eastern cottonwood
37.	P. tremuloides Michx.	Quaking aspen
38.	Prunus americana Marsh.	American plum
39.	P. serotina Ehrh.	Black cherry
40.	P. virginiana L.	Chokecherry
41.	Quercus alba L.	White oak
42.	Q. borealis var. maxima Ashe.	Eastern red oak

43. Q. coccinea Muenchh. ..... Scarlet oak
44. Q. imbricaria Michx. ..... Shingle oak
45. Q. macrocarpa Michx. ..... Bur oak
46. Q. montana Willd. .....Chestnut oak
47. Q. muehlenbergii Engelm. ..... Chinquapin oak
48. Q. stellata Wangenh. ..... Post oak
49. Q. velutina Lam. ..... Black oak
50. Robinia pseudoacacia L. ..... Black locust
51. Salix nigra Marsh. ..... Black willow
52. Sassafras variifolium (Salisb.) Ktze. ..... Sassafras
53. Tilia americana L. ..... American basswood
54. Ulmus americana L. ..... American elm
55. U. alata Michx. ..... Winged elm
56. U. fulva Michx. ..... Slippery elm
57. U. thomasi Sarg. ..... Rock elm

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